Ordering number: EN 2887B

Monolithic Linear IC



No.2887B

LA1805

AM / FM - IF / MPX Tuner System for Radio - Cassette Recorders, Music Centers

Overview

- The LA1805 is a characteristics-improved version of the LA1810, with the same pin assignment and package as those of the LA1810. Improvements are made on the following points:
  - Separation (35dB → 48dB) and its dependence on free-running frequency (Sep − f_F Characteristic on page 4)
  - FM main distortion (0.8% → 0.45%)
  - AM detection output (approximately 5dB increased)

  The constants on five external parts are changed as shown on page 10.

Functions

- FM-IF: IF amp, quadrature detector, soft muting, tuning indicator
- MPX: PLL stereo decoder, stereo indicator, forced monaural, VCO stop
- AM: RF amp, MIX, OSC(with ALC), IF amp, detector, AGC, tuning indicator

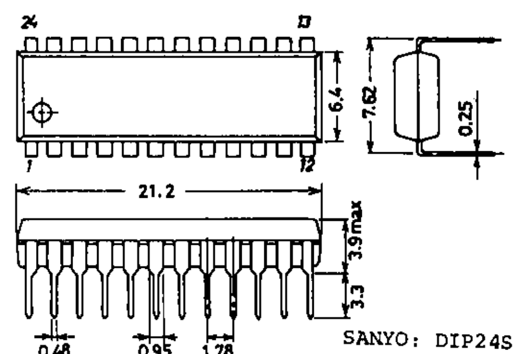
Features

- FM/AM/MPX functions contained on a single chip
- Minimum number of external parts required
- On-chip FM muting function
- High sensitivity
- Less carrier leak of MPX

Maximum Ratings at Ta = 25°C, See specified Test Circuit.

				unit
Maximum Supply Voltage	V_{CC} max	Pins 3,7,8,11,20,21	9	V
Maximum Supply Current	I_{CC} max	Pins 3 + 20 + 21	50	mA
Flow-in Current (Indicator Drive Current)	I_{LED}	Pins 7,8	20	mA
Flow-out Current	I_{23}	Pin 23	0.1	mA
Allowable Power Dissipation	Pd max	Ta≦70°C	500	mW
Operating Temperature	Topr		−20 to +70	°C
Storage Temperature	Tstg		−40 to +125	°C

Package Dimensions
(unit: mm)
3067



Operating Conditions at Ta = 25°C

			unit
Recommended Supply Voltage	V_{CC}	4.5	V
Operating Voltage Range	V_{CC} op	3.0 to 8.0	V

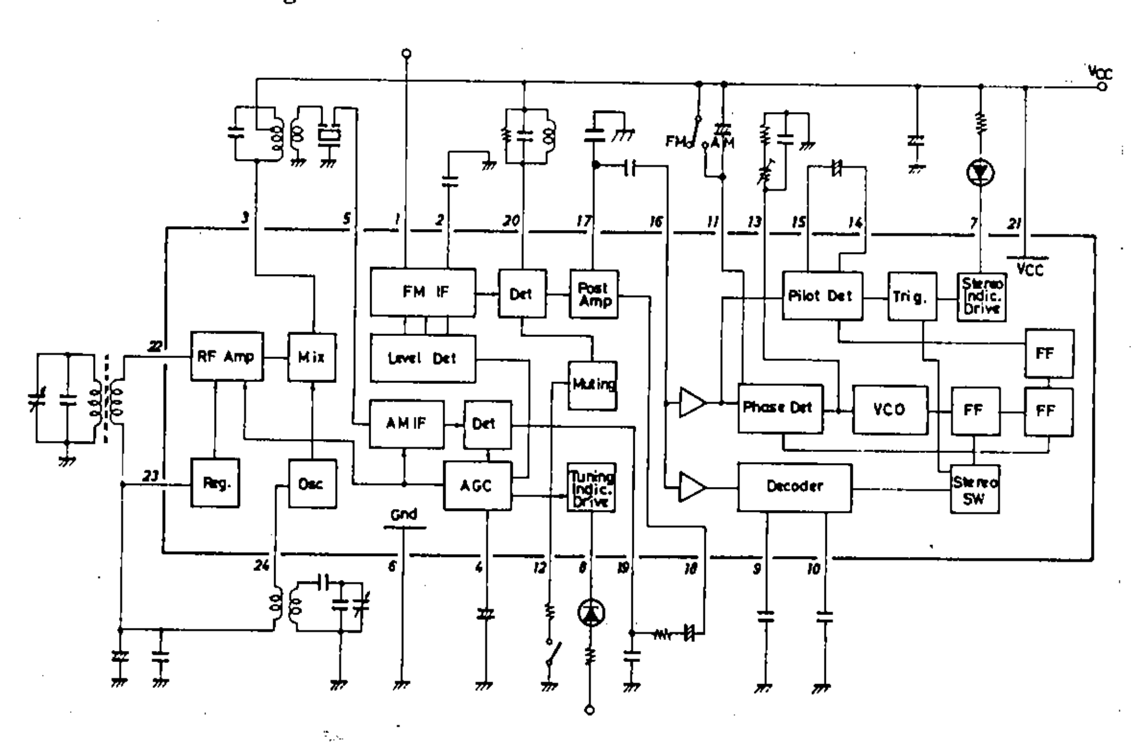
* The FM output level forms an N curve (LA1805) and an S curve (LA1806).
  LA1805: N curve (for US band)
  LA1806: S curve (for Japanese band). Your desired output level can be set by varying the output resistance.

Operating Characteristics at Ta = 25°C, V_{CC} = 4.5V, See specified Test Circuit.

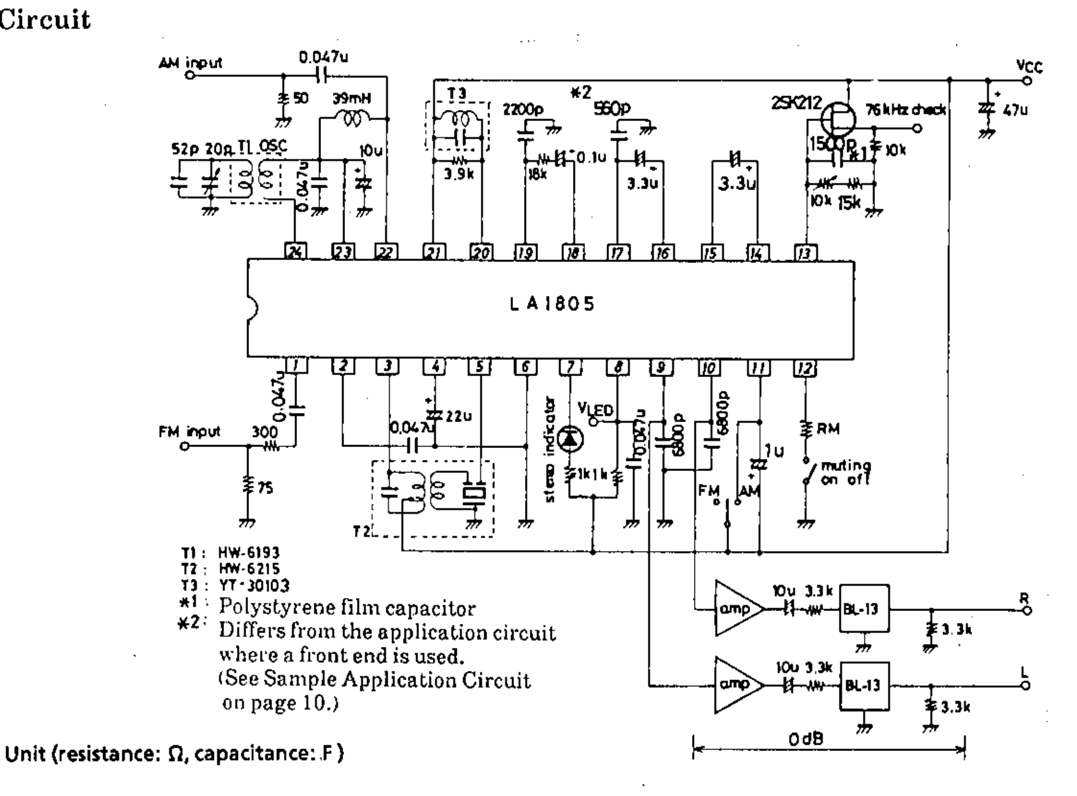
			min	typ	max	unit
FM Characteristics (Mono) : fc = 10.7MHz, fm = 1kHz						
Quiescent Current	Icco	No input		13	20	mA
– 3dB Sensitivity	– 3dB.L.S.	Referenced to V_{IN} = 100dBμ, 100%, down 3dB		28	35	dBμ
Demodulation Output	Vo	V_{IN} = 100dBμ, 100% mod.	140	205	280	mV
Channel Balance	C.B.	V_{IN} = 100dBμ, 100% mod.	0	0	1.5	dB
Total Harmonic Distortion	THD	V_{IN} = 100dBμ, 100% mod.		0.45	1.2	%
Signal to Noise Ratio	S/N	V_{IN} = 100dBμ, 100% mod.	70	80		dB
LED ON Sensitivity	V_{LED}	I_L = 1mA	23	33	43	dBμ
FM Characteristics (Stereo) : fc = 10.7MHz, fm = 1kHz, L + R = 90%, pilot = 10%, V_{IN} = 100dBμ						
Separation	Sep		32	48		dB
Stereo Distortion	THD (Main)			0.45	1.2	%
LED ON Level	V_{LED}-on		2.4	3.9	5.4	%
LED OFF Level	V_{LED}-off			2.7		%
AM Characteristics : fc = 1000kHz, fm = 1kHz						
Quiescent Current	Icco	No input		9.5	14.5	mA
Detection Output	Vo1	V_{IN} = 23dBμ, 30% mod.	27	50	90	mV
	Vo2	V_{IN} = 80dBμ, 30% mod.	70	113	173	mV
Signal to Noise Ratio	S/N1	V_{IN} = 23dBμ, 30% mod.	17	21		dB
	S/N2	V_{IN} = 80dBμ, 30% mod.	50	55		dB
Total Harmonic Distortion	THD1	V_{IN} = 80dBμ, 30% mod.		0.45	1.2	%
	THD2	V_{IN} = 100dBμ, 30% mod.		0.6	1.5	%
LED ON Sensitivity	V_{LED}	I_L = 1mA	16	24	32	dBμ

Note : Be fully careful of dielectric breakdown.

Equivalent Circuit Block Diagram



Test Circuit



How to use the LA1805

1. Forced monaural mode

   Figs.1 and 2 show how to cause the forced monaural mode to be entered.

   ① Connect pin 14 to V_{CC} through a resistor of 100kΩ. (Turn ON the SW1 in Fig.1.)

   ② Connect pin 15 to GND through a resistor of 47kΩ. (Turn ON the SW2 in Fig.2.)

Unit (resistance: Ω)

LA1805 — 14 — 15 — S1 — R1 100k — Vcc — S1 on

Fig.1 Forced Monaural Mode Setting Method

LA1805 — 14 — 15 — S2 — R2 47k — S2 on

Fig.2 Forced Monaural Mode Setting Method

Either above-mentioned ① or ② causes the forced monaural mode to be entered. In this case, the VCO does not stop operating. If the resistance of R1 and R2 are decreased, internal bias will vary and the VCO frequency will vary when the S1 or S2 is turned ON. This data is shown in Fig.3.

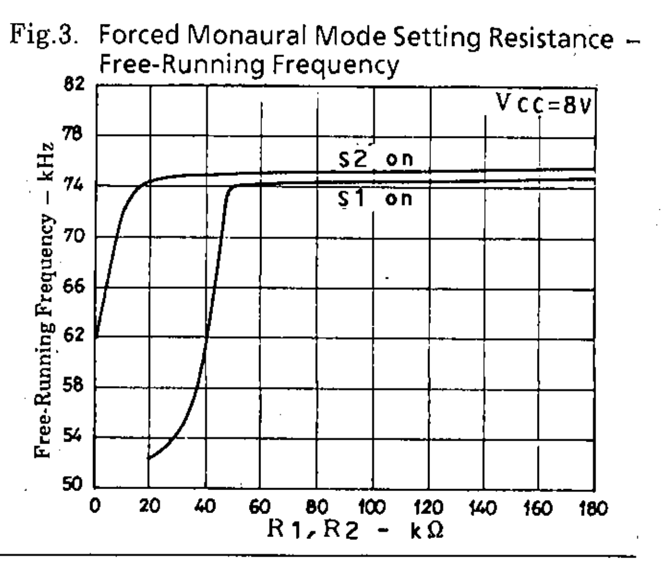


Fig.3. Forced Monaural Mode Setting Resistance – Free-Running Frequency

2. VCO Stop
   The VCO is so designed as to stop automatically at the AM mode.
   (when pin 11 and pin 21 are at the same potential)
   There is no pin available for stopping the VCO at the FM mode. However, the method shown right can be used to stop the VCO at the FM mode, causing the forced monaural mode to be entered.

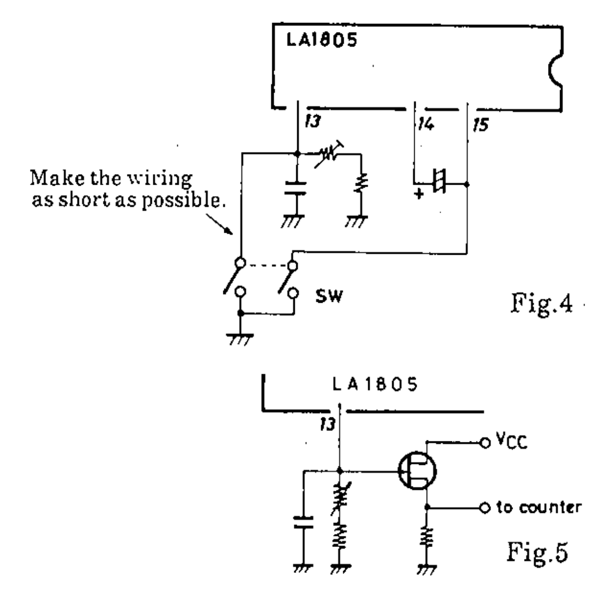


Fig.4

3. Free-running frequency measurement and adjustment
   Either of the following two methods is used to measure the free-running frequency.
   ① Connect pin 13 to a frequency counter through the high input impedance amplifier.

Fig.5

② Connect the connection point of the semifixed resistor connected to pin 13 and the fixed resistor to a frequency counter through the resistor of 240kΩ or greater.

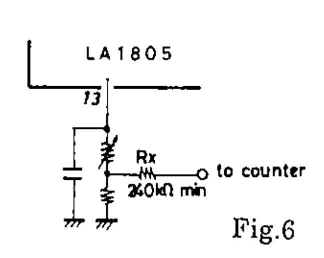
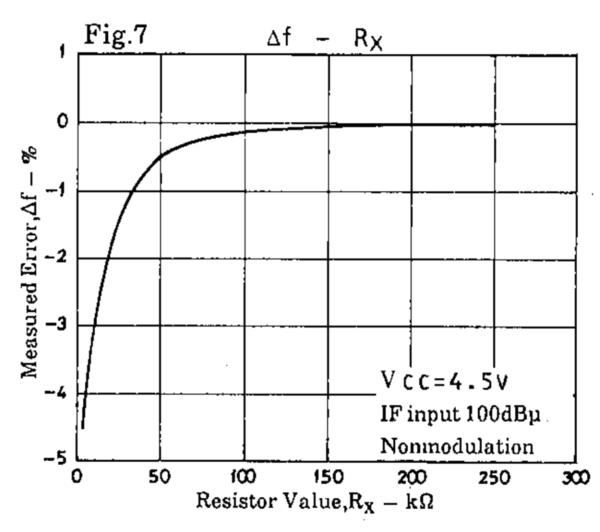


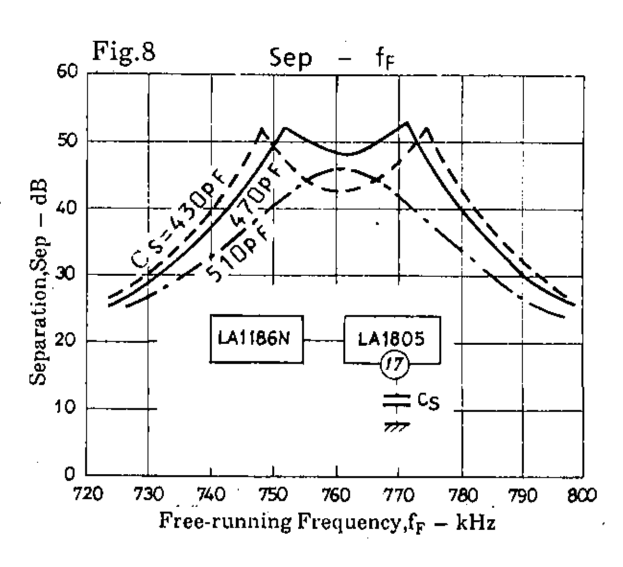
Fig.6

How the error changes with the resistor value is shown in Fig.7



When setting the free-running frequency, the following must be noted.
Apply a 10.7MHz 100dBμ nonmodulation carrier as IF input signal and set to 76kHz±50Hz with the tuning indicator lighted.

4. Separation setting capacitor Cs
   The separation characteristic for the LA1805 alone (IF input) differs from that for the antenna input with a front end. This difference is caused by the characteristics of the front end and ceramic filter. Shown right is how the separation characteristic changes with the separation setting capacitor value when the LA1186N is used as front end. Referring to this separation characteristic, choose the optimum separation for your set model.



5. FM muting pin
   The external resistor connected to pin 12 can be used to vary the muting level (Fig.9). The abnormal sound at the time of side peak reception at the FM mode can be reduced by weak signal muting.

Fig.9 LA1186N + LA1805 Muting Characteristics

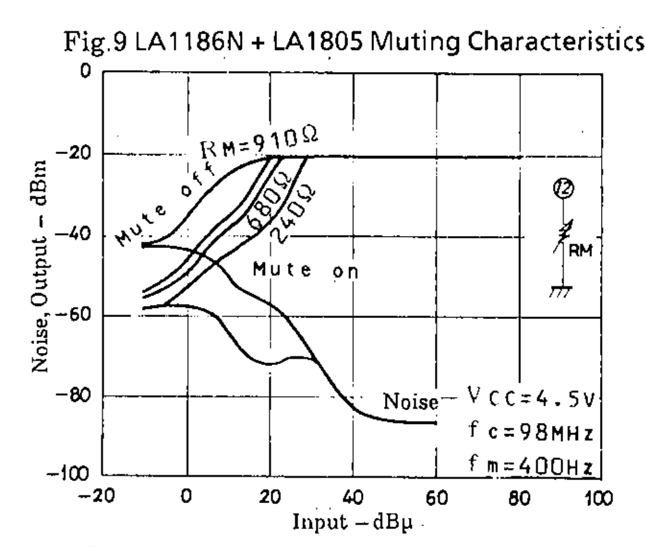
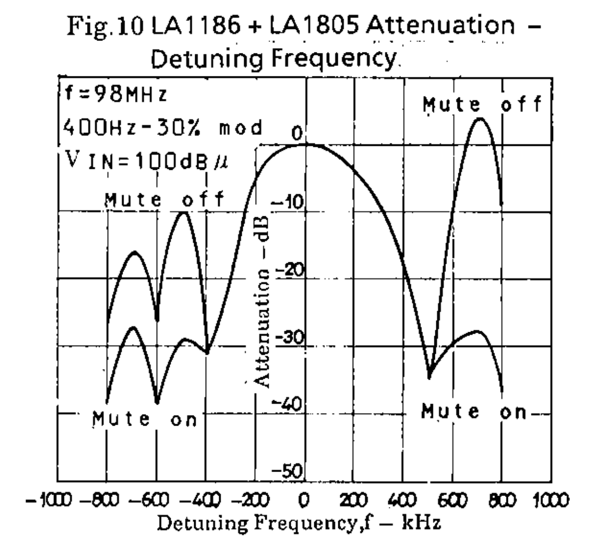


Fig.10 LA1186 + LA1805 Attenuation – Detuning Frequency



6. The following method can be used to change the LED ON sensitivity at the FM mode (Fig.11). The data on the LED ON sensitivity setting resistance and LED ON sensitivity is shown in Fig.12.

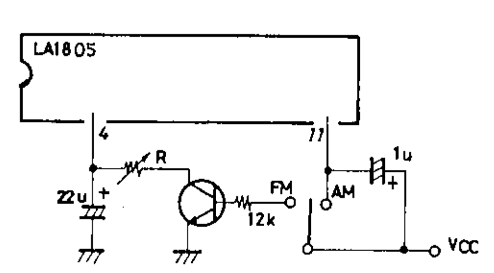
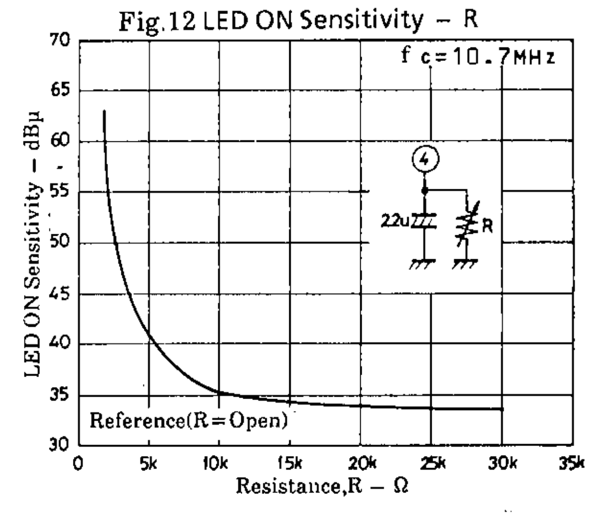


Fig.11 Method to Change the LED ON Sensitivity at the FM Mode

Unit (resistance: Ω, capacitance: F)

Fig.12 LED ON Sensitivity – R



7. AM-FM selection
   The FM mode is entered with pin 11 open as shown in Fig.13. When pin 11 and pin 21 are made to be at the same potential in terms of DC, the AM mode is entered. It should be noted that the dynamic range is narrowed whether the potential at pin 11 is lower or higher than that at pin 21.

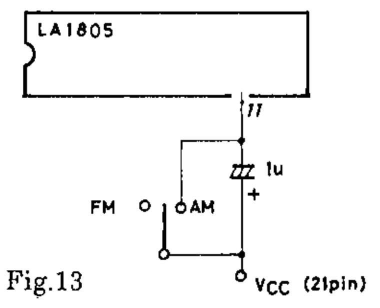
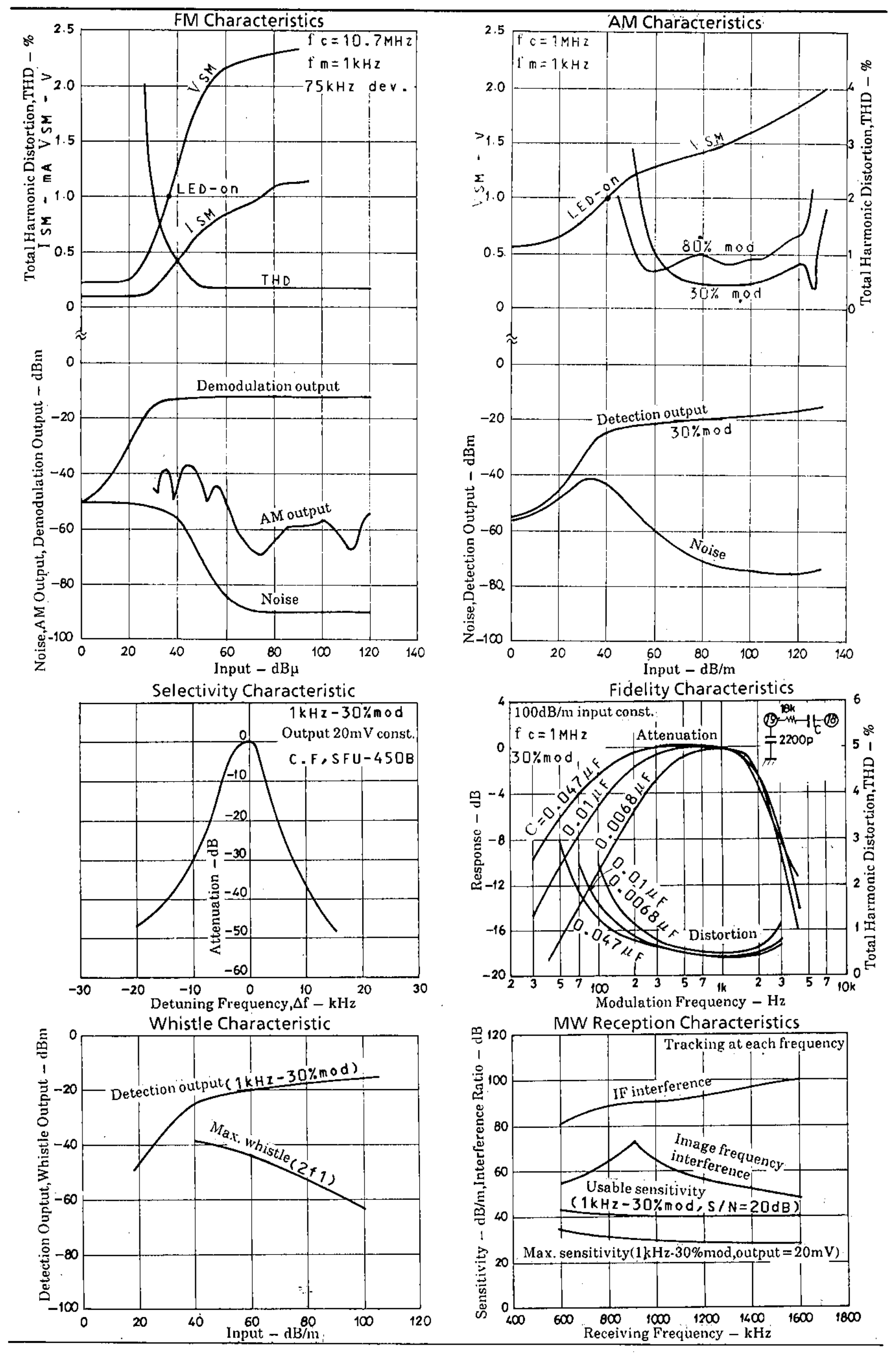
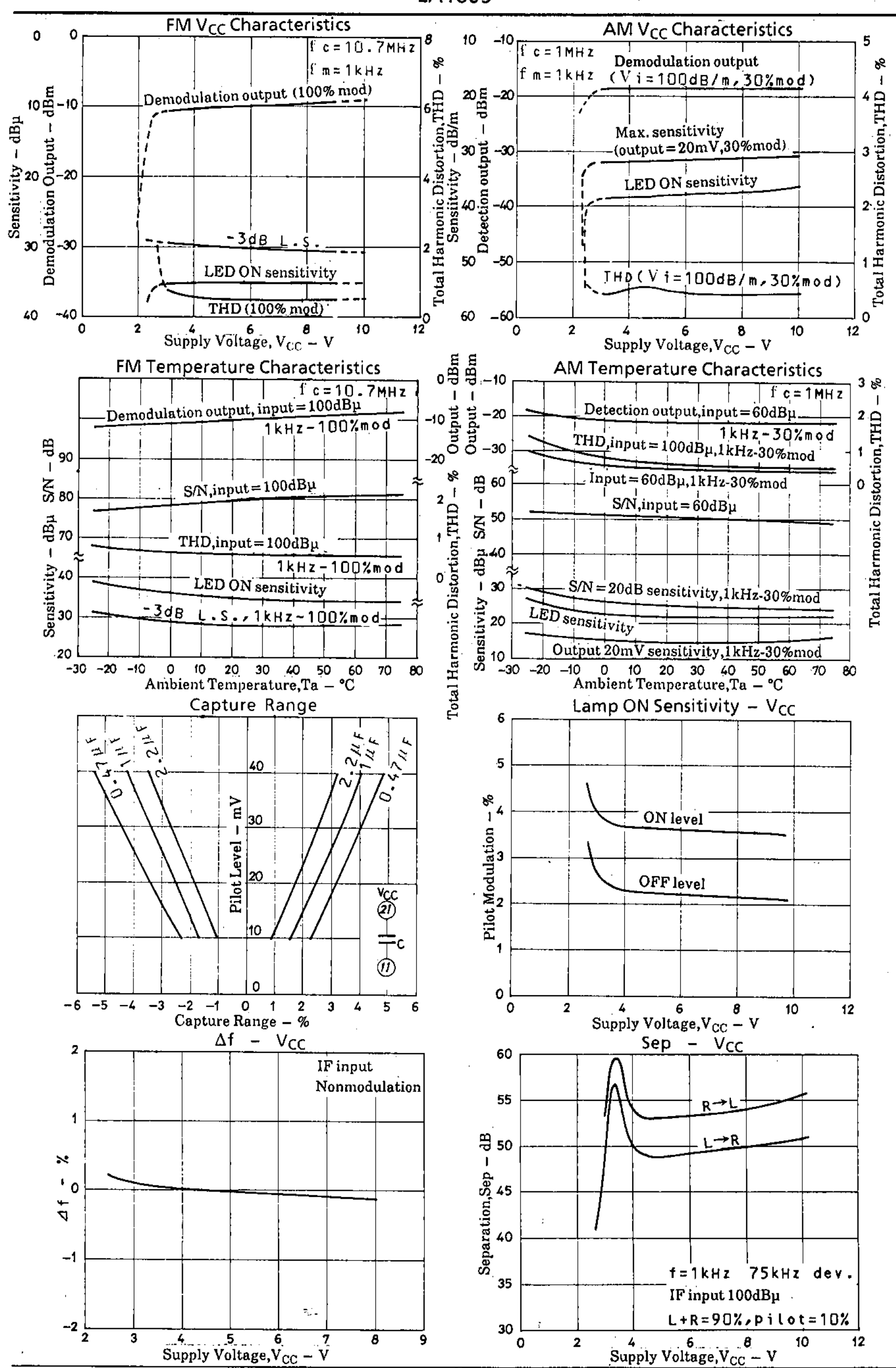


Fig.13

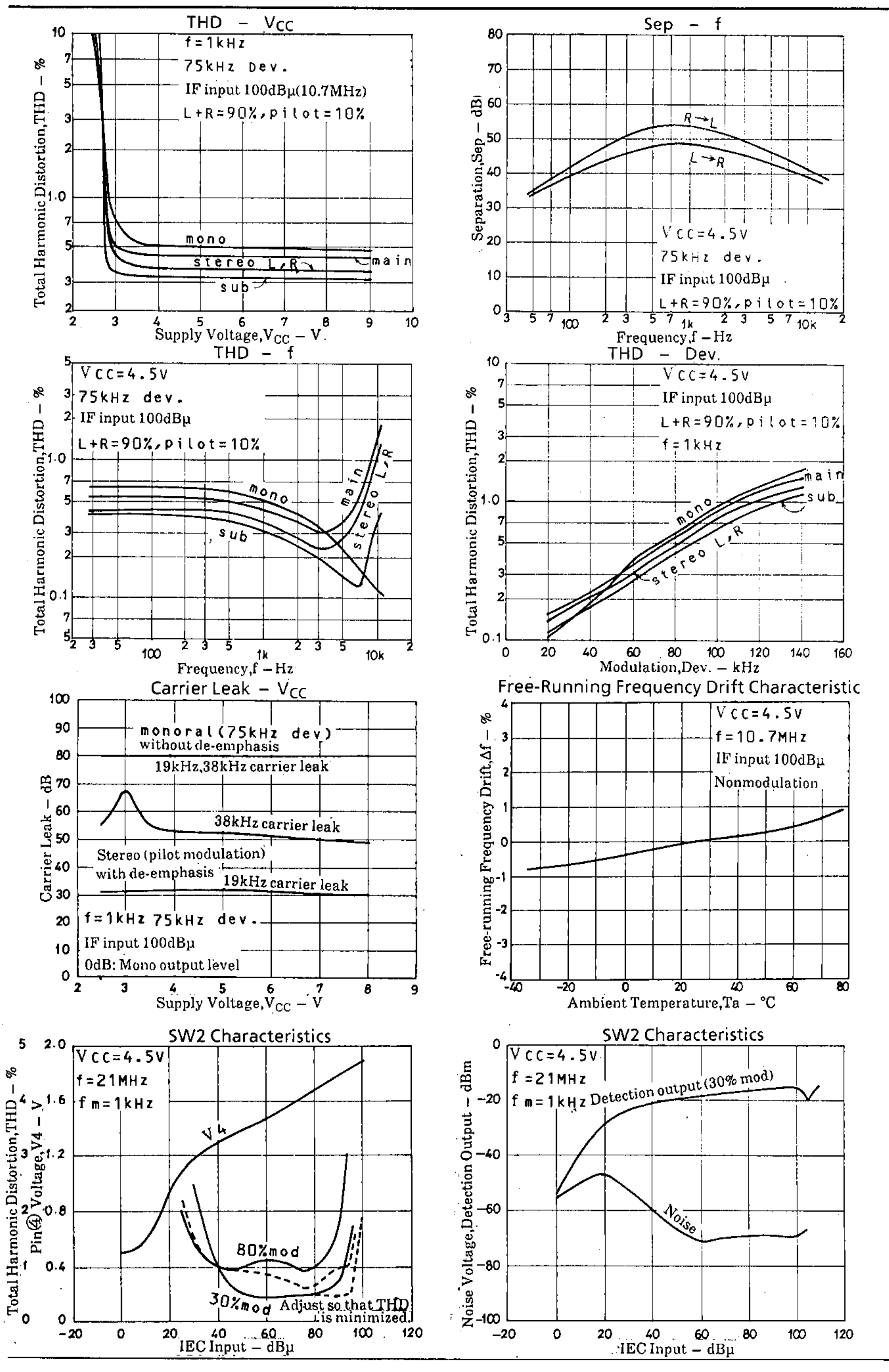
Unit (capacitance: F)

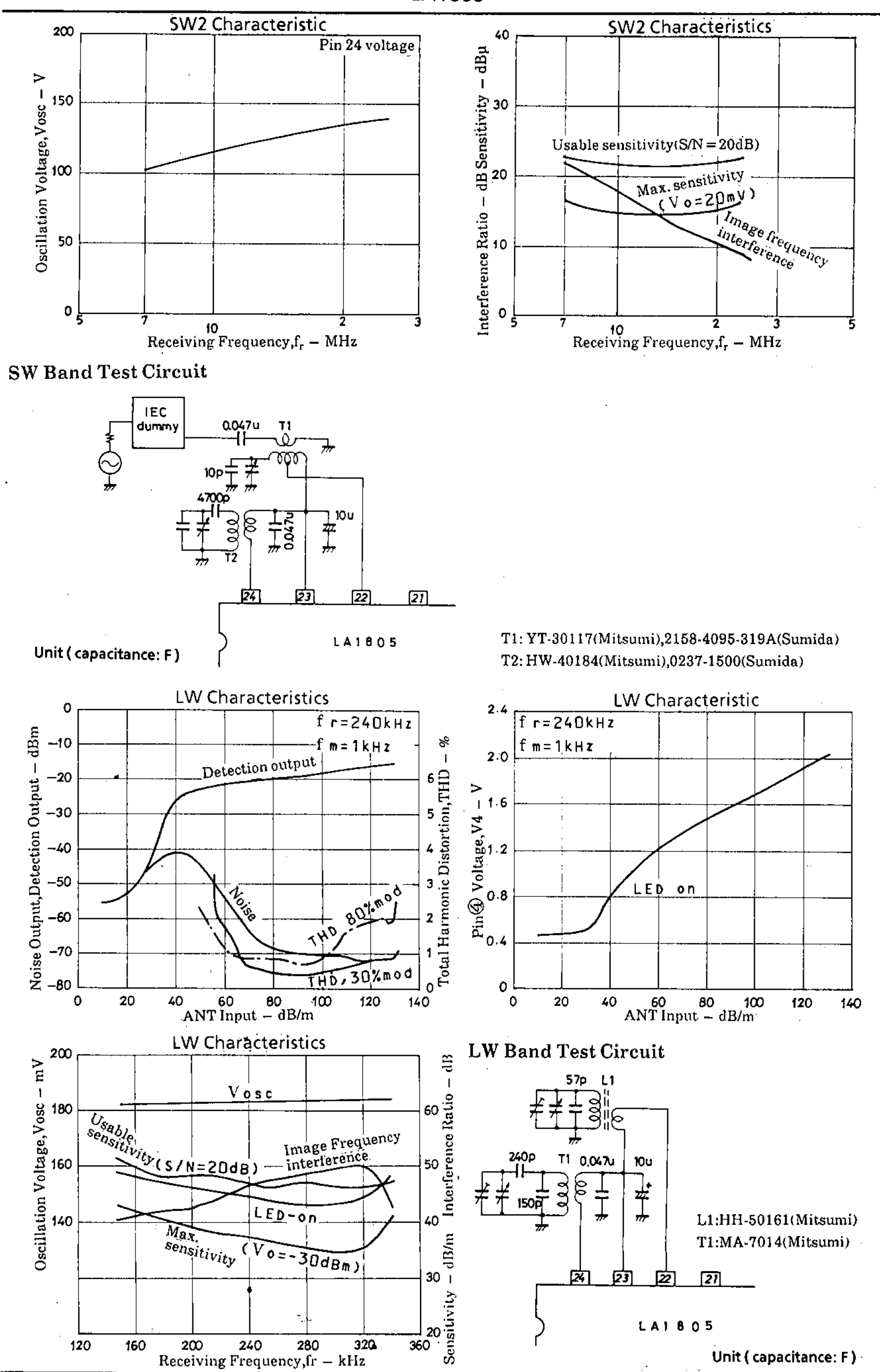
8. If a noise appears in the detection output when the tunig LED goes ON at the AM mode, connect a capacitor across pin 8 and GND to eliminate the noise.


FM Characteristics
fc=10.7MHz
fm=1kHz
75kHz dev.
VSM
LED-on
ISM
THD
Total Harmonic Distortion, THD – %
ISM – mA VSM – V
Demodulation output
AM output
Noise
Noise, AM Output, Demodulation Output – dBm
Input – dBμ
AM Characteristics
fc=1MHz
fm=1kHz
VSM
LED-on
80% mod
30% mod
VSM – V
Total Harmonic Distortion, THD – %
Detection output
30%mod
Noise
Noise, Detection Output – dBm
Input – dB/m
Selectivity Characteristic
1kHz-30%mod
Output 20mV const.
C.F, SFU-450B
Attenuation – dB
Detuning Frequency, Δf – kHz
Fidelity Characteristics
100dB/m input const.
fc=1MHz
30%mod
Attenuation
2200p
C=0.047μF
0.01μF
0.0068μF
Distortion
Response – dB
Total Harmonic Distortion, THD – %
Modulation Frequency – Hz
Whistle Characteristic
Detection output (1kHz-30%mod)
Max. whistle (2f1)
Detection Ouptut, Whistle Output – dBm
Input – dB/m
MW Reception Characteristics
Tracking at each frequency
IF interference
Image frequency interference
Usable sensitivity
(1kHz-30%mod, S/N=20dB)
Max. sensitivity (1kHz-30%mod, output=20mV)
Sensitivity – dB/m, Interference Ratio – dB
Receiving Frequency – kHz



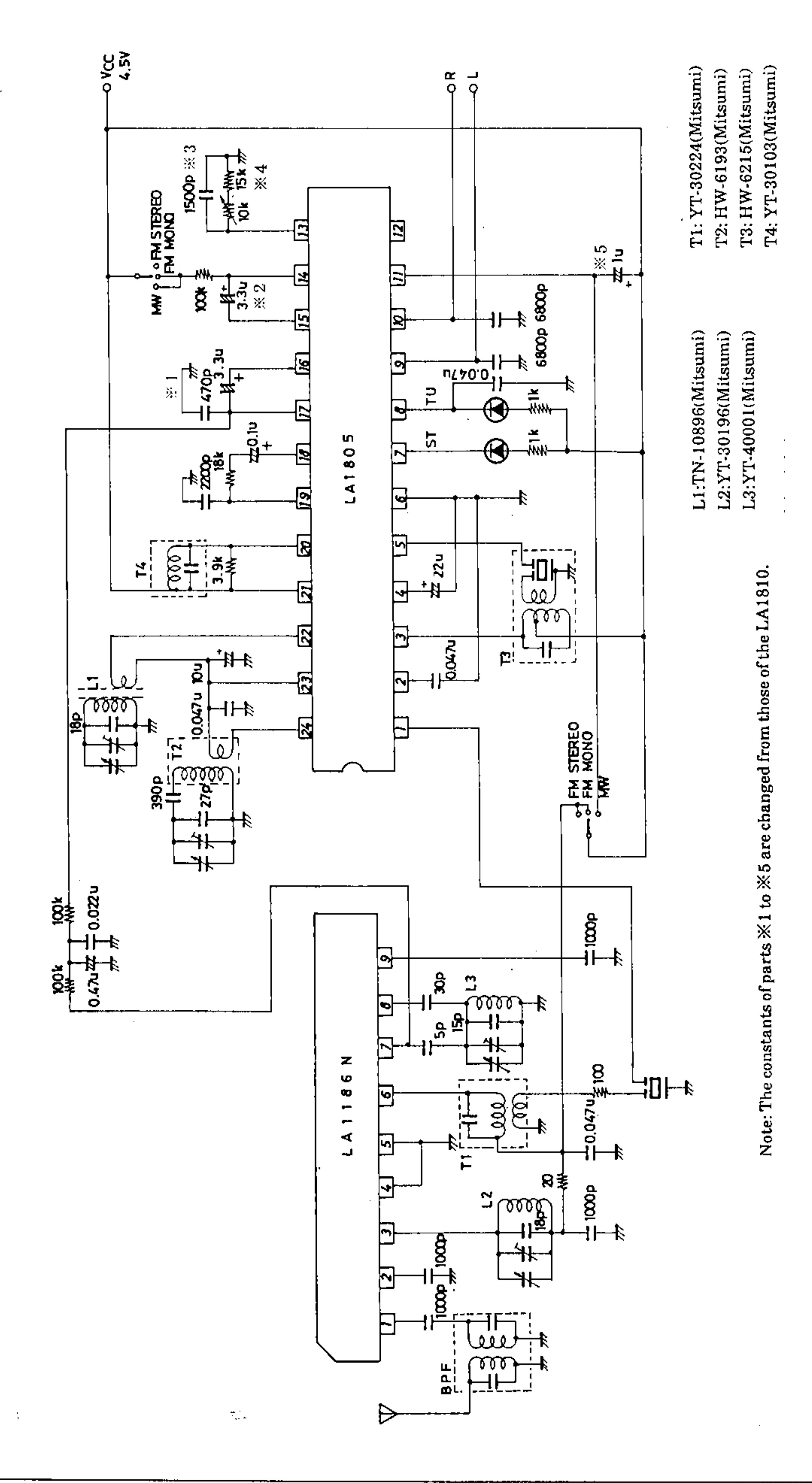
FM V_{CC} Characteristics
fc=10.7MHz
fm=1kHz
Demodulation output (100% mod)
-3dB L.S.
LED ON sensitivity
THD (100% mod)
Sensitivity – dBμ
Demodulation Output – dBm
Total Harmonic Distortion,THD – %
Supply Voltage, V_{CC} – V
AM V_{CC} Characteristics
fc=1MHz
fm=1kHz
Demodulation output
(Vi=100dB/m,30%mod)
Max. sensitivity
(output=20mV,30%mod)
LED ON sensitivity
THD(Vi=100dB/m,30%mod)
Sensitivity – dB/m
Detection output – dBm
Total Harmonic Distortion,THD – %
Supply Voltage,V_{CC} – V
FM Temperature Characteristics
fc=10.7MHz
Demodulation output, input=100dBμ
1kHz-100%mod
S/N,input=100dBμ
THD,input=100dBμ
1kHz-100%mod
LED ON sensitivity
-3dB L.S.,1kHz-100%mod
Sensitivity – dBμ S/N – dB
Output – dBm
Total Harmonic Distortion,THD – %
Ambient Temperature,Ta – °C
AM Temperature Characteristics
fc=1MHz
Detection output,input=60dBμ
1kHz-30%mod
THD,input=100dBμ,1kHz-30%mod
Input=60dBμ,1kHz-30%mod
S/N,input=60dBμ
S/N=20dB sensitivity,1kHz-30%mod
LED sensitivity
Output 20mV sensitivity,1kHz-30%mod
Output – dBm
Sensitivity – dBμ S/N – dB
Total Harmonic Distortion,THD – %
Ambient Temperature,Ta – °C
Capture Range
0.47μF
1μF
2.2μF
Pilot Level – mV
VCC
21
C
11
Capture Range – %
Lamp ON Sensitivity – V_{CC}
ON level
OFF level
Pilot Modulation – %
Supply Voltage,V_{CC} – V
Δf – V_{CC}
IF input
Nonmodulation
Δf – %
Supply Voltage,V_{CC} – V
Sep – V_{CC}
R→L
L→R
f=1kHz 75kHz dev.
IF input 100dBμ
L+R=90%,pilot=10%
Separation,Sep – dB
Supply Voltage,V_{CC} – V

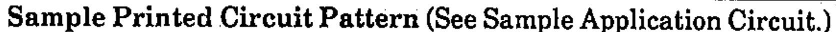

THD – VCC
f=1kHz
75kHz dev.
IF input 100dBμ(10.7MHz)
L+R=90%, pilot=10%
mono
stereo L,R
main
sub
Total Harmonic Distortion,THD – %
Supply Voltage,VCC – V
Sep – f
R→L
L→R
VCC=4.5V
75kHz dev.
IF input 100dBμ
L+R=90%, pilot=10%
Separation,Sep – dB
Frequency,f – Hz
THD – f
VCC=4.5V
75kHz dev.
IF input 100dBμ
L+R=90%, pilot=10%
mono
main
stereo L/R
sub
Total Harmonic Distortion,THD – %
Frequency,f – Hz
THD – Dev.
VCC=4.5V
IF input 100dBμ
L+R=90%, pilot=10%
f=1kHz
main
sub
mono
stereo L,R
Total Harmonic Distortion,THD – %
Modulation,Dev. – kHz
Carrier Leak – VCC
monoral(75kHz dev)
without de-emphasis
19kHz,38kHz carrier leak
38kHz carrier leak
Stereo (pilot modulation)
with de-emphasis
19kHz carrier leak
f=1kHz 75kHz dev.
IF input 100dBμ
0dB: Mono output level
Carrier Leak – dB
Supply Voltage,VCC – V
Free-Running Frequency Drift Characteristic
VCC=4.5V
f=10.7MHz
IF input 100dBμ
Nonmodulation
Free-running Frequency Drift,Δf – %
Ambient Temperature,Ta – °C
SW2 Characteristics
VCC=4.5V
f=21MHz
fm=1kHz
V4
80%mod
30%mod
Adjust so that THD is minimized.
Total Harmonic Distortion,THD – %
Pin④ Voltage,V4 – V
IEC Input – dBμ
SW2 Characteristics
VCC=4.5V
f=21MHz
fm=1kHz
Detection output (30% mod)
Noise
Noise Voltage,Detection Output – dBm
IEC Input – dBμ



SW2 Characteristic
Pin 24 voltage
Oscillation Voltage,Vosc – V
Receiving Frequency,fr – MHz
SW2 Characteristics
Usable sensitivity(S/N = 20dB)
Max. sensitivity (Vo=20mV)
Image frequency interference
Interference Ratio – dB Sensitivity – dBμ
Receiving Frequency,fr – MHz
SW Band Test Circuit
IEC dummy
0.047u
T1
10p
4700p
10u
0.047u
T2
24
23
22
21
LA1805
Unit (capacitance: F)
T1: YT-30117(Mitsumi),2158-4095-319A(Sumida)
T2: HW-40184(Mitsumi),0237-1500(Sumida)
LW Characteristics
fr=240kHz
fm=1kHz
Detection output
Noise
THD 80%mod
THD,30%mod
Noise Output,Detection Output – dBm
Total Harmonic Distortion,THD – %
ANT Input – dB/m
LW Characteristic
fr=240kHz
fm=1kHz
LED on
Pin④ Voltage,V4 – V
ANT Input – dB/m
LW Characteristics
Vosc
Usable sensitivity (S/N=20dB)
Image Frequency interference
LED-on
Max. sensitivity (Vo=-30dBm)
Oscillation Voltage,Vosc – mV
Interference Ratio – dB
Sensitivity – dB/m
Receiving Frequency,fr – kHz
LW Band Test Circuit
57p
L1
240p
T1
0.047u
10u
150p
24
23
22
21
LA1805
L1:HH-50161(Mitsumi)
T1:MA-7014(Mitsumi)
Unit (capacitance: F)

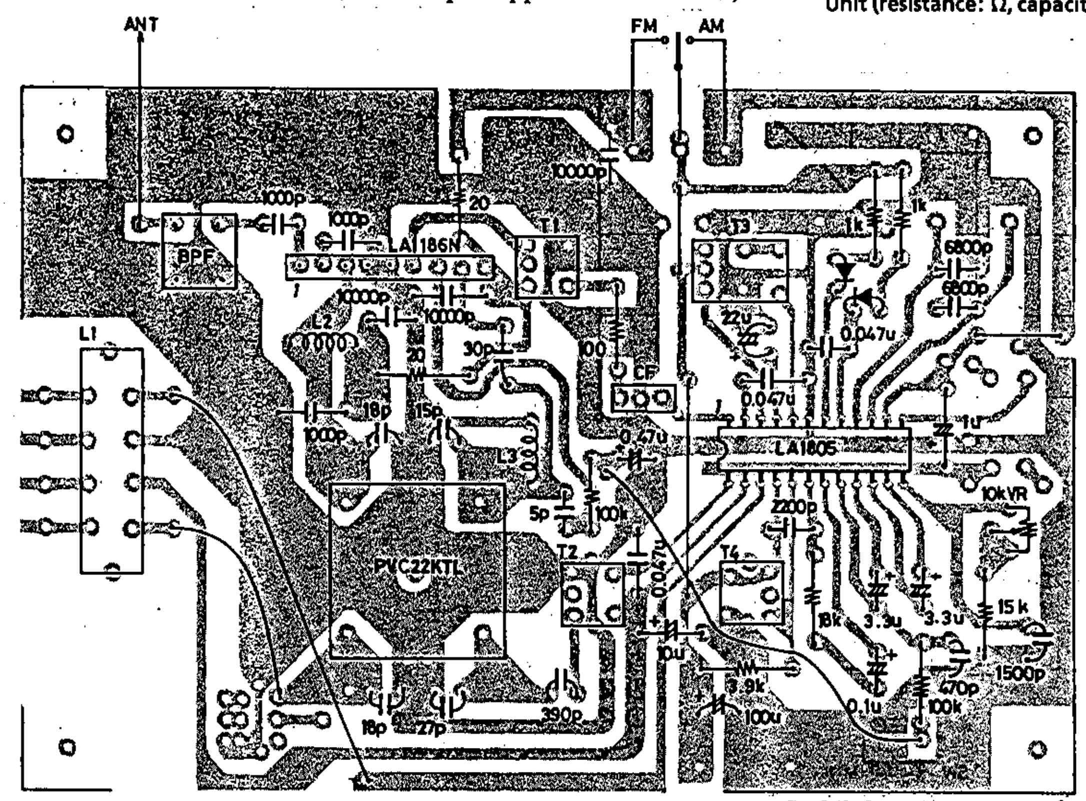
Sample Application Circuit: LA1186N + LA1805 FM/MW



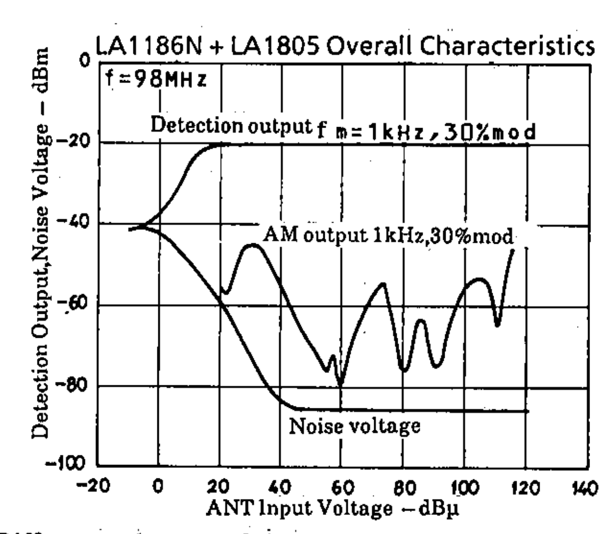


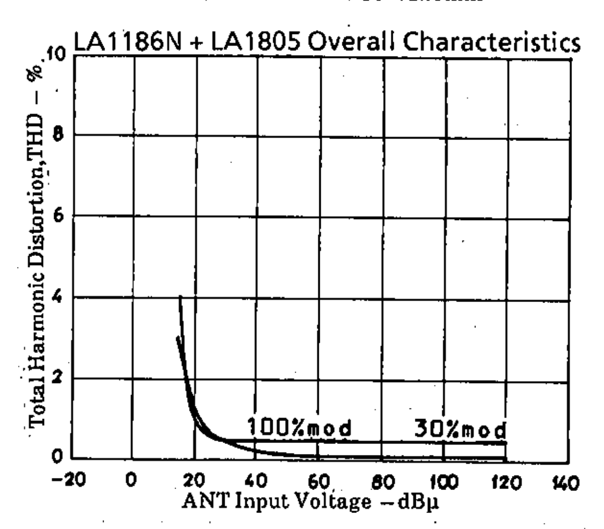
Sample Printed Circuit Pattern (See Sample Application Circuit.)

Unit (resistance: Ω, capacitance: F)



(Cu-foiled area) 80×120mm²

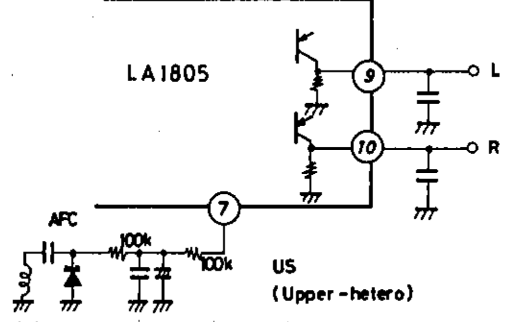




Differences between LA1805 and LA1806

(1) Same pin assignment

(2) The internal circuit of the MPX OUT (pin 9, pin 10) is different as shown below.
The FM S curve at pin 17 is in the opposite direction and the circuit in which AFC is provided is the same for the US band and Japanese band.

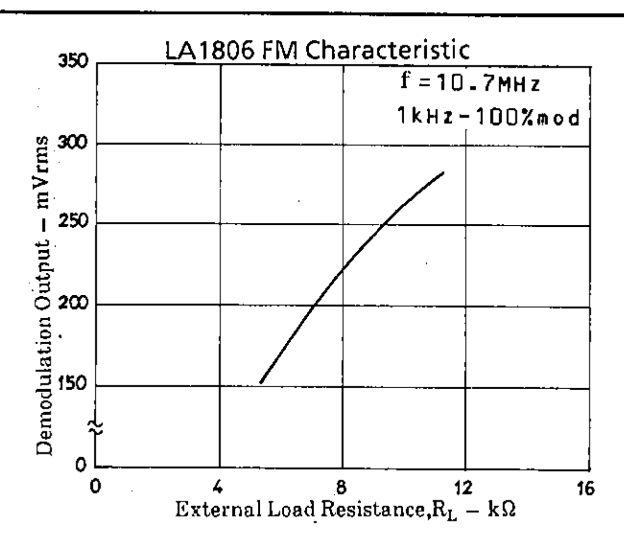


LA1806 — 9 — L — R_L — 10 — R — R_R — 7 — AFC — 100k — 100k — JAPAN (Lower-herero)

The LA1805 contains the output load resistors. (Output load resistance = 6.8kΩ)

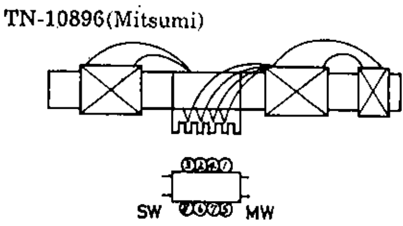
Unit (resistance: Ω)

For the LA1806, output load resistors R_L, R_R are connectedexternally.
The graph of demodulation output vs. $R_L(R_R)$ is shown below.



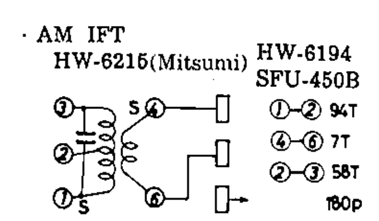
Coil Specifications

· MW bar antenna
TN-10896(Mitsumi)



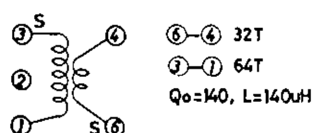
①-② 22T+49T, ③-④ 10T
⑤-⑥ 17T, 0.5ø
⑦-⑧ 4T
①-② L=260uH, Qo=330(≧200)
⑤-⑥ L=15uH, Qo=250(≧150)

· AM IFT
HW-6215(Mitsumi) HW-6194
SFU-450B



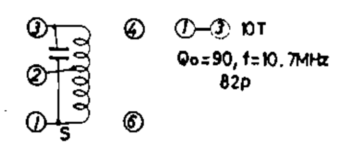
①-② 94T
④-⑥ 7T
②-③ 58T
180p

· MW OSC
HW-6193(Mitsumi)



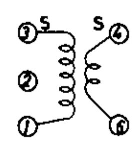
⑥-④ 32T
③-① 64T
Qo=140, L=140uH

· FM quadrature
YT-30103(Mitsumi)



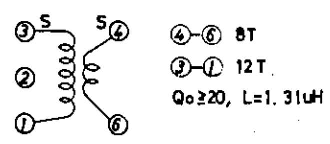
①-③ 10T
Qo=90, f=10.7MHz
82p

· SW2 OSC
HW-40184(Mitsumi)



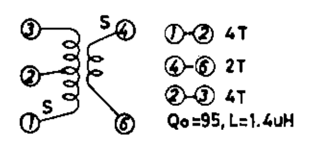
④-⑥ 8T
③-① 12T
Qo≧28, L=1.31uH

0237-1500(Sumida)



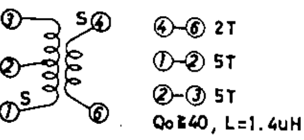
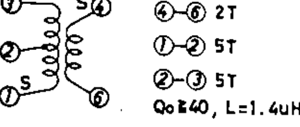
④-⑥ 8T
③-① 12T
Qo≧20, L=1.31uH

· SW2 ANT
YT-30117(Mitsumi)



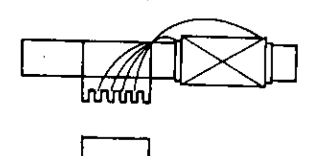
①-② 4T
④-⑥ 2T
②-③ 4T
Qo=95, L=1.4uH

2158-4095-319A(Sumida)

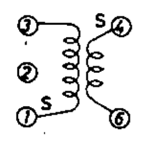
④-⑥ 2T
①-② 5T
②-③ 5T
Qo≧40, L=1.4uH

· LW bar antenna
HH-50161(Mitsumi)



①-② 20T
③-④ 200T
③-④ L=2.74mH, Qo≧200

· LW OSC
MA-7014(Mitsumi)



④-⑥ 40T
①-③ 80T
L=220uH, Qo=130